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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/058,353	01/30/2002	Emi Oguri	01-251	5203
23400	7590	04/08/2004	EXAMINER	
POSZ & BETHARDS, PLC 11250 ROGER BACON DRIVE SUITE 10 RESTON, VA 20190			SONG, MATTHEW J	
			ART UNIT	PAPER NUMBER
			1765	

DATE MAILED: 04/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/058,353

Applicant(s)

OGURI ET AL.

Examiner

Matthew J Song

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 December 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 16-18 and 28-32 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 16-18 and 28-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claim 28 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 28 recites, “a silicon carbide single crystal comprising.....an atom having a smaller atomic radius than silicon and including fluorine contained in a carbon fluoride gas”. The instant claim requires a silicon carbide crystal containing a carbon fluoride **gas**, which suggests the gas is present in the final crystal structure. Applicants’ instant specification teaches reaction of silane, propane, alkyl aluminum and carbon fluoride to form silicon carbide, note page 22. Applicants’ claim requires the carbon fluoride to not react and merely be absorbed into the structure and the carbon fluoride gas to remain in the gaseous state. The high temperature used and the reactivity of the gaseous carbon fluoride is expected to react with the other process gases; therefore the carbon fluoride would not remain in its original state, based on applicants’ disclosure. Furthermore, if carbon fluoride gas was present in the structure; the structure would not be expected to be single crystalline, which is highly oriented, while containing large molecules of carbon tetrafluoride gas in the structure. Also, the

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carbon fluoride gas in the structure would be expected to diffuse through the silicon carbide, further degrading the crystallinity.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 16 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 16 recites, “a metal atom, other than a light metal, having a larger atomic radius than silicon in a crystalline structure thereof and including tantalum” in lines 4-5. It is unclear if applicants intend there are three elements, the dopant, the metal atom and a tantalum element, or if the tantalum element is the metallic atom because tantalum is a metal other a light metal having a larger atomic radius than silicon.

5. Claim 28 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 28 recites, “an atom having a smaller atomic radius than silicon and including fluorine contained in a carbon fluoride gas” in lines 4-5. It is unclear if the carbon fluoride gas is present in the final structure or if fluorine is present in the final structure by using carbon fluoride gas, as a reactive gas.

Claim Rejections - 35 USC § 102

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6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 16-18 and 31 are rejected under 35 U.S.C. 102(b) as being anticipated by Vodakov et al (WO 97/27350).

Vodakov et al discloses a Silicon Carbide (SiC) single crystal containing a 10^{16} cm^{-3} of nitrogen, and a 10^{16} - 10^{17} concentration of tantalum (pg 14, ln 20 to pg 15, ln 15), where nitrogen reads on applicant's n-type dopant and tantalum reads on applicant's metallic atom, other than a light metal having a larger atomic radius than silicon.

Referring to claim 17, Vodakov et al discloses a concentration of 10^{16} cm^{-3} (page 15, ln 1-5).

Referring to claim 18, Vodakov et al discloses a concentration of 10^{16} - 10^{17} (page 15, ln 1-5).

Referring to claim 31, Vodakov et al discloses a nitrogen.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

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having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 28-30 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter et al (US 6,025,289) in view of Larkin et al (US 5,709,745).

Carter et al discloses large single crystal of silicon carbide are grown in furnace sublimation systems and the crystal are grown with compensating levels of p-type and n-type dopants, note entire reference. Carter et al also discloses a single crystal of silicon carbide having a nitrogen dopant and an aluminum dopant, this reads on applicant's p-type dopant having a larger atomic radius than carbon, each being present in the crystal at a concentration of between about $1 \times 10^{16} \text{ cm}^{-3}$ and $1 \times 10^{18} \text{ cm}^{-3}$ and the concentration of aluminum dopant atoms being in the range of about 1 to 5 times that of nitrogen dopant atoms (Abstract and Claim 1). Carter et al is silent to the atomic radius of nitrogen and aluminum, however the atomic radius of aluminum is well known in the art to be larger than carbon and the atomic radius is well known in the art to be less than silicon, note Inomate et al (US 4,827,235) and Aoki et al (US 5,998,609). Carter et al also teaches roughly equal amounts of p-type and n-type dopants are maintained in the

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atmosphere of the sublimation furnace so that compensated levels of these two dopant types are introduced into the crystal lattice structure (col 2, ln 55-60) and other dopants may be used (col 3, ln 55-65).

The Examiner has interpreted claim 28 to require fluorine to be present in the crystalline structure of silicon carbide and not carbon fluoride gas, which is used to supply the fluorine to the crystalline structure.

Carter et al does not teach a silicon carbide structure including fluorine.

In a method of forming single crystalline SiC, note entire reference, Larkin et al teaches forming a single crystal of SiC and regulating the amount of a non-crystal element in a growth area (claim 1 and 7). Larkin et al also teaches n-type doping of SiC by use of n-type dopants, such as nitrogen, fluorine, chlorine and/or sulfur (col 37, ln 1-15). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Carter et al by using fluorine as an n-type dopant because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

Referring to claim 28, the combination of Carter et al and Larkin et al teaches a single crystalline SiC containing Aluminum and fluorine, therefore meets the limitation. Using a carbon fluoride gas to introduce fluorine into the crystalline structure is merely a process limitation and the patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production (MPEP 2113).

Referring to claims 29 and 32, the combination of Carter et al and Larkin et al teaches a p-type dopant of aluminum concentration of 1×10^{16} to 1×10^{18} atoms/cm³ ('289 claim 1). Overlapping ranges are held to be obvious (MPEP 2144.05).

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Referring to claim 30, the combination of Carter et al and Larkin et al teaches aluminum, this reads on applicants' atom having a smaller atomic radius than silicon, having a concentration of 1×10^{16} to 1×10^{18} atoms/cm³ ('289 claim 1).

Referring to claim 32, the combination of Carter et al and Larkin et al teaches p-type dopants of boron, aluminum and gallium ('745 col 37, ln 1-15).

10. Claims 28-30 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter et al (US 6,025,289) in view of Larkin et al (US 5,709,745) as applied to claims 28-30 and 32 above, and further in view of Niwa et al (US 5,019,887).

The combination of Carter et al and Larkin et al teaches forming a single crystalline SiC material containing aluminum and fluorine. The Examiner maintains that fluorine is contained in the silicon carbide crystalline structure and that carbon fluoride gas is not contained because it would disrupt the crystallinity because of the size of molecule and the gaseous molecule would tend to diffuse because it would not be stable. Should evidence be provided that the carbon fluoride molecule is contained in the crystalline structure, the combination of Carter et al and Larkin et al would not teach a carbon fluoride. However, it would be obvious in view of Niwa et al.

In a method of forming SiC, Niwa et al teaches a n-type SiC:H:F film formed using SiF and CF₄ (col 28, ln 25-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Carter et al and Larkin et al by using the well known CF₄ doping gas, as taught by Niwa et al, to dope SiC with fluorine.

Response to Arguments

11. Applicant's arguments with respect to claims 16-18 and 28-32 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Imai et al (US 5,373,171) teaches nitrogen and phosphorus are known n-type impurities for silicon carbide (col 3, ln 45-65).

Barrett et al (US 5,611,955) teaches a silicon carbide single crystal containing vanadium and fluorine (col 3, ln 1-55 and col 4, ln 1-20).

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1765

MJS

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER

